REMARKS

PRIORITY

Enclosed herewith are the Korean foreign priority documents 2000-47347, filed August 8, 2000 and 2000-76694, filed December 14, 2000. Thus, the Examiner's concern about the priority documents is believed to be moot.

CLAIM OBJECTIONS

Claims 9 and 18 are objected to because of informalities.

The square brackets in claims 9 and 18 have been deleted. Thus, claims 9 and 18 are now believed to be in correct form.

CLAIM REJECTIONS UNDER 35 U.S.C. §112

Claims 9 and 18 are rejected under 35 U.S.C. §112, second paragraph, as being indefinite.

Claims 9 and 18 have been amended to define n more clearly. "n" is an integer greater than or equal to 2. Thus, in the terminology " $(C_2S_x.)_n$, x=2.5 to 50, n an integer ≥2" , when n=2, there are 4 C's; when n=3, there are 6 C's; when n=4, there are 8 C's, and so on. Hence, claims 9 and 18 and the term "n2" are now submitted to be clear.

CLAIM REJECTIONS UNDER 35 U.S.C. §102

A. Claims 1-4, 6, 9, 11, 14-20, 22-24, 27 & 28-35 are rejected under 35 U.S.C. §102(e) as being anticipated by Nakagiri et al. (USPN 6,576,370; hereafter, Nakagiri).

The independent claims 1, 15, 24, 27, 28, and 32 have been amended so that each of the claims recites that the organic mixing solvent is selected from the group consisting of dimethylformamide, isopropyl alcohol and acetonitrile, but not including tetrahydrofuran, propylene carbonate or ethylene carbonate, and that the positive active material of the present invention comprises a binder that has at least one polymer selected from the group consisting of polyvinylidene fluoride, polyvinyl acetate and polyvinyl pyrrolidone and an amount of the binder is at least five percent by weight with respect to the positive active material composition.

It is respectfully submitted that the Examiner stated that the organic mixing solvent of the electrolyte inherently has a solubility of sulfur of 1 to 50 mM, but N-methyl pyrrolidone, which is taught by Nakagiri et al., generally is used together with a polyvinylidene fluoride binder, has a solubility of sulfur of 450 mM or more. In addition, N-methyl pyrrolidone exhibits inferior properties in comparison with the solvent that has a sulfur solubility of 1 to 50 mM. This is clearly shown in Table 1 of the specification, which shows the cycle life characteristics and initial discharge capacities of the cells according to Example 1 and Comparative Example 1.

It is respectfully submitted that when Nakagiri et al. utilizes acetonitrile or dimethylformamide, they teach adding organic solvents such as tetrahydrofuran, propylene carbonate, or ethylene carbonate (Example 1, lines 33-62 of col. 9; (Example 2, lines 8-18 of col. 10).

As amended, the present invention utilizes the organic solvents dimethylformamide, isopropyl alcohol and acetonitrile without combining them with tetrahydrofuran, propylene carbonate or ethylene carbonate, as is taught by Nakagiri et al. (see Example 1 in paragraphs 35-38, Example 2 in paragraph 42, Example 3 in paragraph 43 of the specification). In contrast, Nakagiri et al. teaches mixing acetonitrile or dimethylformamide with at least one of tetrahydrofuran, propylene carbonate or ethylene carbonate (see Example 1, Example 2, Example 3 in line 32 of col. 9 through line 18 of col. 10 of Nakagiri et al.). Thus, in the present invention, by utilizing the solvents of the present invention, the solubility of sulfur is maintained equal to or less than 50 mM

Thus, the addition of the limitation of the organic mixing solvent of dimethylformamide, isopropyl alcohol and acetonitrile, but not including tetrahydrofuran, propylene carbonate or ethylene carbonate, together with the limitation that the binder has at least one polymer selected from the group consisting of polyvinylidene fluoride, polyvinyl acetate and polyvinyl pyrrolidone and an amount of the binder is at least five percent by weight with respect to the positive active material composition, is submitted to place the independent claims in form for allowance under 35 U.S.C. §102(e) since the claims are submitted not to be anticipated by Nakagiri.

Since dependent claims 3-4, 6, 9, 11, 14, 17-20, 22, 30-31, and 34-35 depend from the respective amended independent claims, claims 3-4, 6, 9, 11, 14, 17-20, 22, 30-31, and 34-35 are submitted to be allowable for at least the reasons that the respective independent claims are submitted to be allowable.

In accordance with the above arguments, claims 1, 3-4, 6, 9, 11, 14-15, 17-20, 22, 24, 27 & 28, 30-32, and 34-35 are submitted to be allowable under 35 U.S.C. §102(e) and not anticipated by Nakagiri et al. (USPN 6,576,370).

B. Claims 1-5, 9, 10, 14,15-21 & 24-27 are rejected under 35 U.S.C. §102(e) as being anticipated by Geronov et al. (USPN 6,344,293; hereafter, Geronov).

Independent claims 1, 24 and 27 have been amended to recite that the positive active material is utilized for a positive electrode for a lithium-sulfur battery. Independent claims 15, 28, and 32 already include such a limitation. In addition, independent claims 1, 15, 24, 27, 28, and 32 have been amended to recite that an amount of the binder is at least five percent by weight with respect to the positive active material composition.

It is respectfully submitted that, as noted by the Examiner, Geronov teaches (col. 9, lines 8-11): "The **cathode** of the present invention may also comprise a **binder**. The choice of binder material may vary widely so long as it is inert with respect to the other materials in the cathode." (emphasis added) It is respectfully submitted that teaching a cathodic material is not the same as teaching an anodic material, as is recited in the present invention.

An **anode** is the electrode where oxidation (**loss of electrons**) takes place. A **cathode** is the electrode where reduction (**gain of electrons**) takes place. Clearly, chemically speaking, substances that enhance loss of electrons, i.e., substances useful at an anode, are not generally suggestible for use at a cathode. Thus, it is submitted that it is inappropriate to suggest that a material utilized at a cathode is taught or suggested to be used at an anode.

In independent claims 1, 15, 24, 27, 28, and 32, the positive active material composition includes at least 5 percent by weight of binder (see specification, page 5, paragraph 25): "If the amount of binder is less than 5 percent by weight, the effective result is not obtained." Thus, as noted above, the independent claims have been amended to recite that the positive active material composition includes at least five percent by weight of binder. Nakagiri et al. fails to teach a necessity of utilizing at least 5 percent by weight of binder to achieve an effective result.

Since dependent claims 3-5, 9, 10, 14,17-21 & 25-26 depend from the respective amended independent claims, claims 3-5, 9, 10, 14,17-21 & 25-26 are submitted to be allowable for at least the reasons that their respective amended independent claims are submitted to be allowable.

In accordance with the above arguments, claims 1, 3-5, 9, 10, 14,15, 17-21 & 24-27 are submitted to be allowable under 35 U.S.C. §102(e) and not anticipated by Geronov et al. (USPN 6,344,293).

CLAIM REJECTIONS UNDER 35 U.S.C. §103

A. Claim 13 is rejected under 35 U.S.C. §103(a) as being unpatentable over Geronov et al. (USPN 6,344,293; hereafter Geronov) as applied to claims 1 & 5 above, in view of Semel et al. (USPN 5,298,055).

Semel teaches that, in solid state diffusion utilizing allowing powders, certain ratios are utilized to advantage in bonded powder compositions. However, in Semel there is no teaching or suggestion of utilizing the ratios in liquid solvents such as the solvents used in Geronov et al. It is known to those skilled in the art that solids and liquids tend to behave differently. Thus, it is respectfully submitted that Semel does not teach the ratios of binder and the oxide polymer in a liquid. In addition, there is no teaching or suggestion of combining Semel with Geronov.

It is respectfully submitted that, for the reasons noted above, amended claim 1 is not obvious and is thus allowable over Geronov et al. (USPN 6,344,293) as applied to claims 1 & 5 above, in view of Semel et al. (USPN 5,298,055). Since amended claim 1 is submitted to be non-obvious, claim 13 which depends therefrom is submitted to be non-obvious for at least the reasons that amended claim 1 is submitted to be non-obvious and is submitted to be allowable over Geronov et al. (USPN 6,344,293) as applied to claims 1 & 5 above, in view of Semel et al. (USPN 5,298,055).

B. Claim 7 is rejected under 35 U.S.C. §103(a) as being unpatentable over Nakagiri et al. (USPN 6,576,370; hereafter, Nakagiri) as applied to claim 1 above and further in view of Carlson (USPN 6,488,721; hereafter Carlson).

As noted by the Examiner, Nakagiri teaches using a **cathodic** material comprising a polyvinyl **binder** and Carlson teaches using a binder as a **cathodic** mixture. That is, in col. 20, lines 6-15, Carlson states: "The relative amounts of electroactive cathode active material, such as sulfur-containing organic polymer, and other components such as conductive additives, polymeric **binders**, electrolytes, and other additives in the cathode active layer may vary widely. Generally these relative amounts **are determined** by experimentation **and chosen so as to optimize the amount of cathode active material present**, the energy storage capacity of the cathode active layer, **and the electrochemical performance of the cathode** active layer in an electrochemical cell." (emphasis added)

As noted above, **cathodic** materials and **anodic** materials are generally selected for different reasons. Thus, it would not have been obvious to utilize **cathodic** materials in the **anode** (positive electrode) of the present invention. Also, there is no teaching or suggestion of combining the teachings of Nakagiri and Carlson, which teach cathodic materials, and even if combined, they would not teach or suggest the positive active material composition of the positive electrode (i.e., the anode) of the lithium-sulfur battery of the present invention since they apply to the negative electrode. In addition, Even if Carlson teaches using two polymers, it would not have been obvious to combine Nakagiri and Carlson to form an anodic material since both teach using binders in a cathode, rather than an anode, as is recited in the present invention.

It is respectfully submitted that, for the reasons noted above, amended claim 1 is not obvious and is allowable over Nakagiri et al. (USPN 6,576,370) as applied to claim 1 above and further in view of Carlson (USPN 6,488,721).

Since amended claim 1 is submitted to be non-obvious, claim 7 which depends therefrom is submitted to be non-obvious for at least the reasons that amended claim 1 is submitted to be non-obvious and is submitted to be allowable over Nakagiri et al. (USPN 6,576,370) as applied to claim 1 above and further in view of Carlson (USPN 6,488,721).

C. Claim 8 is rejected under 35 U.S.C. §103(a) as being unpatentable over Nakagiri et al. (USPN 6,576,370; hereafter, Nakagiri) as applied to claim 1 above and further in view of Igarashi et al. (USPN 6,573,004; hereafter Igarashi).

As noted by the Examiner, Nakagiri teaches a **cathodic** material comprising an acetonitrile solvent and Igarashi teaches using polyvinylacetate in **cathodic** mixtures.

It is respectfully submitted that, for the reasons noted above, amended claim 1 is not obvious and is allowable over Nakagiri et al. (USPN 6,576,370; hereafter, Nakagiri) as applied to claim 1 above and further in view of Igarashi et al. (USPN 6,573,004; hereafter Igarashi). As noted above, **cathodic** materials and **anodic** materials are generally selected for different reasons. Thus, it would not have been obvious to utilize **cathodic** materials in the **anode** (positive electrode) of the present invention. Also, there is no teaching or suggestion of combining the teachings of Nakagiri and Igarashi, which teach cathodic materials, and even if combined, they would not teach or suggest the positive active material composition of the positive electrode (i.e., the anode) of the lithium-sulfur battery of the present invention since they apply to the negative electrode.

Since amended claim 1 is submitted to be non-obvious, claim 8 which depends therefrom is submitted to be non-obvious for at least the reasons that amended claim 1 is submitted to be non-obvious and is submitted to be allowable over Nakagiri et al. (USPN 6,576,370) as applied to claim 1 above and further in view of Igarashi et al. (USPN 6,573,004).

CONCLUSION

In accordance with the foregoing, claims 1, 9, 15, 18, 24, 27, 28, and 32 have been amended. Claims 2, 12, 16, 23, 29 and 33 have been cancelled without prejudice or disclaimer. Claims 1, 3-11, 13-15, 17-22, 24-28, 30-32 and 34-35 are pending and under consideration.

There being no further outstanding objections or rejections, it is submitted that the application is in condition for allowance. An early action to that effect is courteously solicited.

Finally, if there are any formal matters remaining after this response, the Examiner is requested to telephone the undersigned to attend to these matters.

If there are any additional fees associated with filing of this Amendment, please charge the same to our Deposit Account No. 19-3935.

Respectfully submitted,
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